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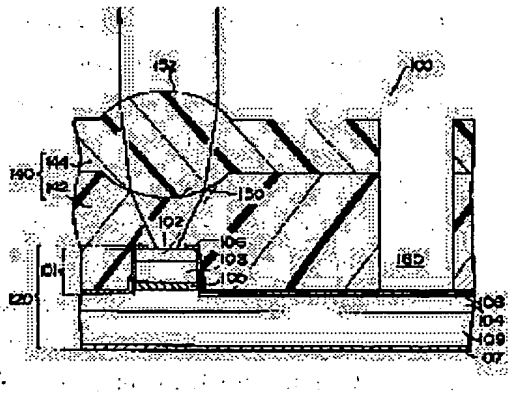
(54) SURFACE EMISSION SEMICONDUCTOR LASER AND METHOD OF FABRICATION

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a surface emission semiconductor laser, and a method of fabrication, which can resist against substances, e.g. oxygen or moisture, causing deterioration in the performance of semiconductor and in which the radiation angle of laser light can be set low.
SOLUTION: The surface emission semiconductor laser 100 has a resonator formed in the vertical direction on a semiconductor substrate 109 and emits laser light from the resonator in the direction perpendicular to the semiconductor substrate 109. A light transmitting multilayer structure 140 comprising a plurality of light transmitting layers 142, 144 is provided on a semiconductor deposition structure 120 including the resonator. At least two interfaces among the interfaces of the light transmitting layers 142, 144 have lens faces 150, 152 above the resonator. The method for fabricating the surface emission semiconductor laser 100 preferably comprises a step for forming at least one light transmitting layer constituting the light transmitting multilayer structure 140 using a stamper.



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CLAIMS

[Claim(s)]

[Claim 1] On a semi-conductor substrate, have a vertical resonator and carry out outgoing radiation of the laser beam in the direction perpendicular to this semi-conductor substrate from this resonator. A light transmission nature layered product is prepared on the semi-conductor deposition object which is field luminescence mold semiconductor laser and contains said resonator. Said light transmission nature layered product At least two interfaces among the interfaces of said light-permeability layer are field luminescence mold semiconductor laser which has [the laminating of two or more light-permeability layers is carried out, they are constituted, and / above said resonator] the lens side.

[Claim 2] Field luminescence mold semiconductor laser which has the lens side on the top face of said light-permeability layer of the maximum upper layer among said interfaces of said light-permeability layer in claim 1.

[Claim 3] It is the field luminescence mold semiconductor laser said each light-permeability layer of whose is a resin layer in claims 1 or 2.

[Claim 4] Said light transmission nature layered product is field luminescence mold semiconductor laser from which the laminating of a high refractive-index light-permeability layer and the low refractive-index light-permeability layer is carried out by turns in either of claims 1-3 and which they consist of.

[Claim 5] It is the field luminescence mold semiconductor laser whose optical axis of said resonator and each of said lens side corresponds in either of claims 1-4.

[Claim 6] Said light transmission nature layered product is field luminescence mold semiconductor laser in which the contact hole for taking [in / in either of claims 1-5, said semi-conductor deposition object has an electrode, and / a predetermined location] said electrode and contact is established.

[Claim 7] It is the field luminescence mold semiconductor laser in which said light transmission nature layered product has two or more resonators in either of claims 1-6, and the separation slot is established in said mutual light transmission nature layered product of said resonator.

[Claim 8] It is the field luminescence mold semiconductor laser which has a part concave convex in the flat-surface configuration of said separation slot in claim 7.

[Claim 9] Field luminescence mold semiconductor laser with which the protection-from-light nature ingredient is filled up into said separation Mizouchi in claims 7 or 8.

[Claim 10] It is the field luminescence mold semiconductor laser from which said field luminescence mold semiconductor laser has two or more resonators in either of claims 1-9, and said resonator is arranged by the predetermined pattern, and constitutes the surface light source.

[Claim 11] It is the field luminescence mold semiconductor laser by which said field luminescence mold semiconductor laser is applied to a laser beam printer in claim 10.

[Claim 12] The manufacture approach including the process which forms said at least one light-permeability layer which is the manufacture approach of a surface emission-type laser according to claim 1 to 11, and constitutes said light transmission nature layered product using La Stampa of a surface emission-type laser.

[Claim 13] It is the manufacture approach of field luminescence mold semiconductor laser that surface treatment to which adhesion with said light-permeability layer to which said La Stampa contacts the mold side and this La Stampa in claim 12 becomes lower than the adhesion of said light-permeability layer of the lowest layer and said semi-conductor deposition object is performed.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the field luminescence mold semiconductor laser which carries out outgoing radiation of the laser beam perpendicularly to a semi-conductor substrate, and its manufacture approach.
[0002]
[Background of the Invention] Field luminescence mold semiconductor laser has the description with an isotropic and laser radiation angle of being small, compared with end-face laser. When field luminescence mold semiconductor laser is applied to the optical fiber of a large core diameter, for example, a plastic optical fiber, incidence of the laser beam can be directly carried out efficiently into a fiber for the above-mentioned description. Therefore, the optical-communication module of a very easy configuration is realizable by combining a plastic optical fiber and field luminescence mold semiconductor laser.
[0003]
[Problem(s) to be Solved by the Invention] However, since there is a fault that transfer loss is large, in order to lengthen a transmission distance, the light source of a big optical output is needed for a plastic optical fiber. In order to increase the laser output of field luminescence mold semiconductor laser, it is effective to enlarge laser outgoing radiation aperture. However, if laser outgoing radiation aperture is enlarged, the problem that a radiation angle becomes large will arise. It results directly in causing the fall of the quantity of light of the laser beam in which increase of a radiation angle carries out incidence to joint effectiveness, i.e., fiber incore, reduction of an installation margin, etc., direct coupling, i.e., when incidence is performed for a laser beam to an optical fiber, for simplification of the configuration of an optical transmitting module. Therefore, there was a problem that coexistence of simplification of securing the die length of a transmission distance and the configuration of the optical transmitting module by direct coupling was difficult.
[0004] Furthermore, if the semi-conductor which constitutes field luminescence mold semiconductor laser has exposed field luminescence mold semiconductor laser, degradation of the engine performance will be caused by oxygen, moisture, etc.
[0005] The purpose of this invention makes it possible to set up the radiation angle of a laser beam small, and is to offer the field luminescence mold semiconductor laser which is further tolerant to the matter which degrades the engine performance of semi-conductors, such as oxygen and moisture, and its manufacture approach.
[0006]
[Means for Solving the Problem] The field luminescence mold semiconductor laser of this invention has a vertical resonator on a semi-conductor substrate. It is the field luminescence mold semiconductor laser which carries out outgoing radiation of the laser beam in the direction more nearly perpendicular to this semi-conductor substrate

than this resonator. A light transmission nature layered product is prepared on the semi-conductor deposition object containing said resonator, the laminating of two or more light-permeability layers is carried out, said light transmission nature layered product is constituted, and, as for at least two interfaces, it has the lens side [above said resonator] among the interfaces of said light-permeability layer.

[0007] According to the field luminescence mold semiconductor laser of this invention, the following operation effectiveness can be done so, for example.

[0008] (1) As for the field luminescence mold semiconductor laser of this invention, at least two interfaces have the lens side [above said resonator] among the interfaces of said light-permeability layer. That is, the light transmission nature layered product has two or more lens sides. By this, the field luminescence mold semiconductor laser of this invention can do the following operation effectiveness so.

[0009] ** Since a light transmission nature layered product has two or more lens sides, compared with the case where it has a single lens side, power (for example, condensing function) of a lens can be enlarged. For this reason, the radiation angle of a laser beam can be set up small.

[0010] ** A desired lens operation can be acquired by controlling and combining the configuration (for example, curvature) of each lens side, the refractive index of each light-permeability layer, etc. A desired lens operation is a lens operation of amendment of spherical aberration and chromatic aberration etc.

[0011] ** A desired lens operation can be acquired, without the case where the number of lens sides is one enlarging the curvature of each lens side.

[0012] ** Even if it does not choose the quality of the material to which it is a monolayer and a refractive-index difference becomes large compared with the case where the number of lens sides is one about the quality of the material of a light-permeability layer, a desired lens operation can be acquired. That is, width of face of the refractive index which can be chosen can be enlarged about the quality of the material of a light-permeability layer. Consequently, the width of face of the quality of the material of a light-permeability layer spreads.

[0013] (2) The light transmission nature layered product is formed on the semi-conductor deposition object. For this reason, the semi-conductor deposition object is protected from the matter (for example, oxygen, moisture) which degrades a semi-conductor by the light transmission nature layered product.

[0014] Field luminescence mold semiconductor laser can take at least one mode among the following seven modes.

[0015] (1) It is the mode which has the lens side on the top face of said light-permeability layer of the maximum upper layer among said interfaces of said light-permeability layer in the 1st.

[0016] (2) It is the mode said each light-permeability layer of whose is a resin layer the 2nd. The laminating of the light-permeability layer can be easily carried out to each light-permeability layer being a resin layer by La Stampa.

[0017] (3) Said light transmission nature layered product is a mode which the laminating of a high refractive-index light-permeability layer and the low refractive-index light-permeability layer is carried out by turns the 3rd, and is constituted. The refractive-index difference between light-permeability layers can be enlarged. For this reason, lens power can be enlarged more.

[0018] (4) It is the mode whose optical axis of said resonator and each of said lens side corresponds with the 4th. The optical axis of a laser beam finally emitted by this can be kept perpendicular to a semi-conductor substrate.

[0019] (5) In the 5th, said semi-conductor deposition object has an electrode, and said light transmission nature layered product is a mode in which the contact hole for taking said electrode and contact is established in a predetermined location.

[0020] (6) It is the mode by which said light transmission nature layered product has two or more resonators in the 6th, and the separation slot is established in it in said mutual light transmission nature layered product of said resonator. Thereby, a cross talk can be stopped. A cross talk is explained in full detail in the place of the gestalt of the 2nd operation.

[0021] As for a separation slot, it is desirable to take at least one mode between the following two modes.

[0022] ** The flat-surface configuration of said separation slot is a mode which has a concave convex part. By having a concave convex part, laser beams can be scattered about and a cross talk can be stopped more.

[0023] ** It is the mode with which the protection-from-light nature ingredient is filled up into said separation Mizouchi. Since a protection-from-light nature ingredient absorbs a laser beam, it can stop a cross talk more.
[0024] (7) It is the mode which said field luminescence mold semiconductor laser has two or more resonators in the 7th, and said resonator is arranged in it by the predetermined pattern, and constitutes the surface light source in it. In the case of this mode, field luminescence mold semiconductor laser is applied suitable for a laser beam printer.
[0025] As for the above field luminescence mold semiconductor laser, it is desirable to be manufactured by the manufacture approach of field luminescence mold semiconductor laser including the process which forms said at least one light-permeability layer which constitutes said light transmission nature layered product using La Stampa.
[0026] According to the manufacture approach of this field luminescence mold semiconductor laser, the light-permeability layer which has a desired configuration can be obtained using La Stampa. For this reason, the manufacture approach of this field luminescence mold semiconductor laser can manufacture field luminescence mold semiconductor laser easily compared with the manufacture approach of the field luminescence mold semiconductor laser using a photolithography.
[0027] Moreover, since La Stampa can be used repeatedly again, it can reduce a manufacturing cost.
[0028] As for said La Stampa, it is still more desirable that surface treatment to which adhesion with said light-permeability layer in contact with the mold side and this La Stampa becomes lower than the adhesion of said light-permeability layer of the lowest layer and said semi-conductor deposition object is performed. In case La Stampa is exfoliated from a light-permeability layer by performing such surface treatment, the exfoliation can be performed easily.
[0029]
[Embodiment of the Invention] Hereafter, the gestalt of suitable operation of this invention is explained, referring to a drawing.
[0030] The field luminescence mold semiconductor laser (henceforth a "surface emission-type laser") concerning the gestalt of {gestalt of the 1st operation} the 1st operation and its manufacture approach are explained.
[0031] [Surface emission-type laser] The surface emission-type laser concerning the gestalt of the 1st operation is explained first. Drawing 1 is the sectional view showing typically the surface emission-type laser 100 concerning the gestalt of the 2nd operation.
[0032] (Structure of a device) On the n mold GaAs substrate 109, the laminating of the lower DBR mirror 104, the quantum well barrier layer 105, the up DBR mirror 103, and the contact layer 102 is carried out one by one, and they are formed. The lower DBR mirror 104 consists of distribution reflective mold multilayers mirrors of 25 pairs which carried out the laminating of aluminum0.15Ga0.85As and the AlAs by turns. the quantum well barrier layer 105 — GaAs with a thickness of 3nm — a well — from a layer and an aluminum0.3Ga0.7As barrier layer with a thickness of 3nm — changing — this — a well — a layer consists of three layers. The up DBR mirror 103 consists of distribution reflective mold multilayers mirrors of 30 pairs which carried out the laminating of aluminum0.15Ga0.8 5As and the aluminum0.9Ga0.1As by turns.
[0033] The up DBR mirror 103 is used as p mold by doping Zn. Let the lower DBR mirror 104 be n mold by doping Se. Therefore, a pin diode is formed by the quantum well barrier layer 105 and the lower DBR mirror 104 by which the up DBR mirror 103 and the impurity are not doped.
[0034] The quality of the material of the contact layer 102 will not be limited especially if it is the quality of the material which is mentioned later and in which the up electrode 106 and ohmic contact are possible. As the quality of the material of the concrete contact layer 102, aluminum0.15Ga0.85As by which it was doped in the case of the AlGaAs system ingredient (for example, three or more [1019cm -] high-concentration impurities) can be mentioned.
[0035] The pillar-shaped section 101 is formed by etching in the shape of a mesa except for a predetermined field to the middle of the contact layer 102, the up DBR mirror 103, the quantum well barrier layer 105, and the lower DBR mirror 104.

[0036] Furthermore, the side face of the pillar-shaped section 101 reaches in part, and as an insulating layer 108 covers the top face of the lower DBR mirror 104, it is formed.

[0037] And on the top face of the pillar-shaped section 101, as the up electrode 106 contacts the contact layer 102 and in the shape of a ring and covers a part of side face of the exposed pillar-shaped section 101, and front face of an insulating layer 108, it is formed. Moreover, the lower electrode 107 is formed in the bottom of the n mold GaAs substrate 109.

[0038] Hereafter, the layer structure from the lower electrode 107 to the up electrode 106 is called "semi-conductor deposition object 120."

[0039] On the semi-conductor deposition object 120, the light transmission nature layered product 140 is formed. The laminating of the 1st light-permeability layer 142 and 2nd light-permeability layer 144 is carried out one by one, and the light transmission nature layered product 140 is constituted.

[0040] The interface of the 1st light-permeability layer 142 and the 2nd light-permeability layer 144 has the 1st lens side 150 [above the pillar-shaped section 101]. The 1st lens side 150 is a convex at the n mold GaAs substrate 109 side (below). The 1st lens side 150 has the function to make the laser beam by which outgoing radiation was carried out from the pillar-shaped section 101 condense.

[0041] The front face of the 2nd light-permeability layer 144 has the 2nd lens side 152 [above the pillar-shaped section 101]. The 2nd lens side 152 is a convex in the n mold GaAs substrate 109 and the opposite side (above). The 2nd lens side 152 has the function to make the laser beam by which outgoing radiation was carried out from the pillar-shaped section 101 condense further.

[0042] The biconvex lens is formed in the 2nd light-permeability layer 144 in respect of [152] the 1st lens 150 and the 2nd lens. And the optical axis of the pillar-shaped section 101, the 1st lens side 150, and the 2nd lens side 152 is in agreement.

[0043] The quality of the material of the 1st light-permeability layer 142 is determined by relation with the quality of the material of the 2nd light-permeability layer 144. That is, compared with the 2nd light-permeability layer 144, the quality of the material of the 1st light-permeability layer 142 will not be limited, especially if a refractive index is the small quality of the material. The ingredient which was stiffened by giving energy to a liquefied object as the quality of the material of the 1st and 2nd penetrable layers 142,144, and was obtained is desirable. The reason nil why such an ingredient is desirable is that it can form the light transmission nature layered product 140 using La Stampa mentioned later.

[0044] Especially the thickness of each light-permeability layer 142,144 is set up in consideration of the refractive index of a light-permeability layer 142,144, the configuration of the lens side 150,152, etc., although not limited. The thickness of each light-permeability layer 142,144 is 10-100 micrometers.

[0045] As for the light transmission nature layered product 140, the contact hole 160 is formed in the position. The contact hole 160 is formed so that some up electrodes 106 may be exposed. The path of a contact hole 160 will not be limited especially if it is extent which can form wiring. When forming wiring with a spatter or plating, as for the path of a contact hole 160, it is desirable that it is 10 micrometers or more. When forming wiring by wire bonding, as for the path of a contact hole 160, it is desirable that it is 100 micrometers or more.

[0046] (Actuation) Actuation of a surface emission-type laser 100 is explained hereafter.

[0047] With the up electrode 106 and the lower electrode 107, the electrical potential difference of the forward direction is impressed to a pin diode. Then, in the quantum well barrier layer 105, the recombination of an electron and an electron hole happens and recombination radiation arises. Then, in case the produced light goes back and forth between the up DBR mirror 103 and the lower DBR mirrors 104, induced emission happens and luminous intensity is amplified. If the Mitsutoshi profit turns around optical loss a top, laser oscillation will happen and outgoing radiation of the laser beam will be carried out from the pillar-shaped section 101. Incidence is carried out to the light transmission nature layered product 140, it is condensed in the 1st lens side 150 and the 2nd lens side 152, and the laser beam by which outgoing radiation was carried out from the pillar-shaped section 101 is emitted to a way (it is perpendicularly to the n mold GaAs substrate 109) outside the light transmission nature layered product 140. Namely, in the 1st lens side 150, the laser beam by which outgoing radiation was carried out

from the pillar-shaped section 101 is refracted in the direction approaching the normal to a curve of the 1st lens side 150, and is refracted in the 2nd lens side 152 in the direction which keeps away to the normal to a curve of the 2nd lens side 152.

[0048] (The focus and the operation effectiveness) The focus about a surface emission-type laser 100 and the operation effectiveness concerning the gestalt of this operation are described hereafter. The characteristic point of the surface emission-type laser 100 concerning the gestalt of this operation is the following point.

[0049] (1) It is that the light transmission nature layered product 140 has the 1st lens side 150 and the 2nd lens side 152 in the 1st. The following operation effectiveness is done so by this.

[0050] ** Since the light transmission nature layered product 140 has two lens sides 150,152, it can raise a condensing function compared with the case where it has a single lens side. For this reason, the radiation angle of a laser beam can be set up small.

[0051] ** A desired lens operation can be acquired by controlling the configuration (for example, curvature) of each lens side 150,152, the refractive index of each light-permeability layer 142,144, etc. A desired lens operation is a lens operation of amendment of spherical aberration and chromatic aberration etc.

[0052] ** A desired lens operation can be acquired, without the case where the number of lens sides is one enlarging the curvature of each lens side 150,152.

[0053] ** Even if it does not choose the quality of the material to which it is a monolayer and a refractive-index difference becomes large compared with the case where the number of lens sides is one about the quality of the material of a light-permeability layer, a desired lens operation can be acquired. That is, width of face of the refractive index which can be chosen can be enlarged about the quality of the material of a light-permeability layer 142,144. Consequently, the width of face of the quality of the material of a light-permeability layer 142,144 spreads.

[0054] (2) The light transmission nature layered product 140 is formed on the semi-conductor deposition object 120. For this reason, the semi-conductor deposition object 120 is protected from the matter (for example, oxygen, moisture) which degrades a semi-conductor by the light transmission nature layered product 140.

[0055] The [manufacture approach of a surface emission-type laser], next the manufacture process of the surface emission-type laser 100 concerning the gestalt of the 1st operation are explained. Drawing 2 - drawing 4 are the sectional views showing the production process of a surface emission-type laser typically.

[0056] (Formation of a semi-conductor deposition object) The formation approach of the semi-conductor deposition object 120 is explained first. Drawing 2 is the sectional view showing typically the formation process of the semi-conductor deposition object 120.

[0057] (1) As shown in deposition process drawing 2 (a) of a semi-conductor layer, form the lower DBR mirror 104 on the n mold GaAs substrate 109. The lower DBR mirror 104 carries out the laminating of aluminum0.15Ga0.85As and the AlAs by turns, and is formed by doping Se. Next, the quantum well barrier layer 105 is formed on the lower DBR mirror 104. the quantum well barrier layer 105 — GaAs with a thickness of 3nm — a well — from a layer and an aluminum0.3Ga0.7As barrier layer with a thickness of 3nm — changing — this — a well — a layer consists of three layers. Furthermore, the up DBR mirror 103 is formed on the quantum well barrier layer 105. The up DBR mirror 103 is the laminated structure of 30 pairs which carried out the laminating of aluminum0.15Ga0.85As and the aluminum0.9Ga0.1As by turns, and doped Zn. Then, the laminating of the contact layer 102 which consists of aluminum0.15Ga0.85As on the up DBR mirror 103 is carried out.

[0058] above-mentioned each class — organic metal vapor growth (MOVPE:Metal-OrganicVapor Phase Epitaxy) — by law, epitaxial growth can be carried out and it can form. At this time, for example, growth temperature, 750 degrees C and a growth pressure are 2x104Pa. As an III group raw material, the organic metal of TMGa (trimethylgallium) and TMAl (trimethylaluminum) is used, and it is AsH3 as a V group raw material. It can use. Moreover, DEZn (dimethyl zinc) can be used for n mold dopant at H2Se and p mold dopant.

[0059] Next, a photoresist is applied on the contact layer 102. Then, by the photolithography method, patterning of the photoresist is carried out and the 1st resist layer R1 of a predetermined pattern is formed.

[0060] (2) As shown in the formation process, next drawing 2 (b) of the pillar-shaped section, by using the 1st

resist layer R1 as a mask, to the middle of the contact layer 102, the up DBR mirror 103, the quantum well barrier layer 105, and the lower DBR mirror 104, etch in the shape of a mesa and form the pillar-shaped section 101. The reactant ion-beam-etching method for having used chlorine or chlorine-based gas (a hydrogen chloride and BCl3) as etching gas is usually used for this etching.

[0061] (3) Form silicon oxide (SiOX film) of 100-300nm of thickness on the formation process of an insulating layer and an electrode, next a substrate. SiH4 gas (mono silane) and O2 gas (oxygen) are used for silicon oxide, and it is N2. It is formed by the ordinary pressure heat CVD method which makes gas (nitrogen) carrier gas. Then, by the photolithography method and dry etching, as shown in drawing 2 (c), except for a part of side face of the pillar-shaped section 101, and a part of lower DBR mirror 104, etching removal of the silicon oxide is carried out, and an insulating layer 108 is formed.

[0062] Next, an Au-germanium alloy and the lower electrode 107 which carried out the laminating of nickel and the Au one by one are formed in the inferior surface of tongue of a substrate 109 with a vacuum deposition method. Furthermore, the up electrode 106 is formed by the lift-off method so that it may contact the contact layer 102 and in the shape of a ring on the top face of the pillar-shaped section 101 and the side face and insulating layer 108 of the pillar-shaped section 101 may be covered. Here, the metal layer which carried out the laminating of titanium, platinum, and the gold one by one is used for the up electrode 106.

[0063] (Formation of a light transmission nature layered product) Next, how to form the light transmission nature layered product 140 on the semi-conductor deposition object 120 is explained. Drawing 3 and drawing 4 show the production process of the light transmission nature layered product 140. In drawing 3 and drawing 4 R> 4, illustration of the layer structure of the semi-conductor deposition object 120 is omitted, the outline of the semi-conductor deposition object 120 is carried out, and it is shown.

[0064] The light transmission nature layered product 140 is formed by carrying out sequential formation of the 1st light-permeability layer 142 and 2nd light-permeability layer 144. Hereafter, the formation approach of the 1st light-permeability layer 142 and the 2nd light-permeability layer 144 is explained, respectively.

[0065] <formation of the 1st light-permeability layer> -- the formation approach of the 1st light-permeability layer 142 is explained first. Drawing 3 is the sectional view showing typically the formation process of the 1st light-permeability layer 142.

[0066] (1) As shown in lamination process drawing 3 (a) of the back up plate, stick the back up plate 170 on the rear face of the semi-conductor bank load 120, and the bottom which is specifically the lower electrode 107 if needed. Although the back up plate 170 will not be limited especially if it is flat, it can mention a glass plate etc. preferably. The following operation effectiveness is done so by sticking the back up plate 170.

[0067] 1) The mechanical strength of the semi-conductor deposition object 120 can be raised to the 1st.

[0068] 2) To the 2nd, destruction of the semi-conductor deposition object 120 can be prevented certainly. That is, in the process which exfoliates from the semi-conductor deposition object 120, distortion produces 1st La Stampa 180 mentioned later on the semi-conductor deposition object 120. By sticking the 170 back up plate, destruction of the semi-conductor deposition object 120 by this distortion can be prevented certainly.

[0069] (2) Carry out alignment for 1st La Stampa 180 of an alignment process of the 1st La Stampa and a semi-conductor deposition object, and the semi-conductor deposition object 120. 1st La Stampa 180 has the 1st heights 184 and 2nd heights 186. This alignment is performed so that the 1st heights 184 of 1st La Stampa 180 may be located on the pillar-shaped section 101 of a surface emission-type laser.

[0070] As for 1st La Stampa 180, in the mold side 182 of 1st La Stampa 180, it is desirable that the next surface treatment is performed. That is, it is the surface treatment to which the adhesion of the mold side 182 and 1st light-permeability layer 142 becomes lower than the adhesion of the 1st light-permeability layer 142 and the semi-conductor deposition object 120. As concrete surface treatment, it is the fluoridization. An operation of this surface treatment explains 1st La Stampa 180 at the exfoliating process. As the alignment approach, the following approaches can be mentioned, for example.

[0071] 1) It is the approach of positioning separately 1st La Stampa 180 and the semi-conductor deposition object 120 to the 1st, and making it rivaling in mechanical precision.

[0072] 2) It is the approach of carrying out an alignment mark (not shown) to collimation when 1st La Stampa 180 is transparent, and performing alignment to the 2nd. An alignment mark can be attached on the field of the near semi-conductor deposition object 120 with which the pillar-shaped section 101 is formed.

[0073] 3) It is the approach of preparing perpendicularly the hole (not shown) which penetrates 1st La Stampa 180 in the predetermined part of 1st La Stampa 180, and performing alignment to the 3rd through the hole using an above-mentioned alignment mark when 1st La Stampa 180 is not transparent.

[0074] (3) Introduce 1st liquefied light-permeability layer precursor 142a between the introductory process of the 1st light-permeability layer precursor, next 1st La Stampa 180 and the semi-conductor deposition object 120. And 1st light-permeability layer precursor 142a is carried on the field of the semi-conductor deposition object 120. In addition, light-permeability layer precursor 142a may be carried on the mold side 182 of 1st La Stampa 180. Moreover, after carrying light-permeability layer precursor 142a on the field of the semi-conductor deposition object 120, alignment of 1st La Stampa 180 and the semi-conductor deposition object 120 may be carried out.

[0075] When 1st light-permeability layer precursor 142a becomes the 1st light-permeability layer 142, the ingredient of 1st light-permeability layer precursor 142a will not be limited especially if the refractive index of the 1st light-permeability layer 142 becomes smaller than the refractive index of the 2nd light-permeability layer 144. 1st desirable light-permeability layer precursor 142a is an ingredient hardened by giving energy. As an ingredient hardened by giving energy, the precursor of the resin of an ultraviolet curing mold and the precursor of the resin of a heat-curing mold can be mentioned. As a precursor of the resin of an ultraviolet curing mold, the precursor of the acrylic resin of an ultraviolet curing mold and the precursor of the epoxy system resin of an ultraviolet curing mold can be mentioned, for example. As a precursor of the resin of a heat-curing mold, the precursor of the polyimide system resin of a heat-curing mold etc. can be mentioned.

[0076] Since it can harden only by UV irradiation, the resin of an ultraviolet curing mold can be used easily. Moreover, since heat treatment is not added, it is not necessary to worry about the trouble resulting from the differential thermal expansion between 1st La Stampa 180, the semi-conductor deposition object 120, the back up plate 170, etc. The acrylic resin of an ultraviolet curing mold fits the lens at the highly transparent point.

[0077] By carrying out heating cure processing, an imide-ized reaction occurs, the precursor of the polyimide system resin of a heat-curing mold is hardened, and polyimide system resin produces it. Polyimide system resin has 80% or more of permeability in a light field, and since the refractive index is as high as 1.7-1.9, it has the advantage that the big lens effectiveness is acquired. Moreover, in the case of the resin of a heat-curing mold, 1st La Stampa 180 can consist of the opaque quality of the material. In this case, a metal is also applicable as the quality of the material of 1st La Stampa 180.

[0078] Especially as the introductory approach of a up to [the semi-conductor deposition object 120 of 1st light-permeability layer precursor 142a], although not limited, the approach of trickling and introducing 1st light-permeability layer precursor 142a on the semi-conductor deposition object 120 by the dispenser nozzle can be mentioned, for example.

[0079] (4) As shown in the 1st adhesion process, next drawing 3 (b) of La Stampa and a semi-conductor deposition object, stick 1st La Stampa 180 and the semi-conductor deposition object 120 through 1st light-permeability layer precursor 142a. By this adhesion, 1st light-permeability layer precursor 142a can be applied and extended to the predetermined field between 1st La Stampa 180 and the semi-conductor deposition object 120. In addition, in case 1st La Stampa 180 and the semi-conductor deposition object 120 are stuck if needed, either [at least] 1st La Stampa 180 or the semi-conductor deposition object 120 may be pressurized. Moreover, in order to prevent air bubbles mixing in the interior of 1st light-permeability layer precursor 142a, 1st La Stampa 180 and the semi-conductor deposition object 120 may be stuck under an about 10Pa vacuum.

[0080] (5) Harden the hardening process of the 1st light-permeability layer precursor, next 1st light-permeability layer precursor 142a. As for the hardening approach, a proper approach is chosen according to the class of 1st light-permeability layer precursor 142a. When the resin of an ultraviolet curing mold is used, it can harden by irradiating ultraviolet rays from the 1st La Stampa 180 side at 1st light-permeability layer precursor 142a. When

the precursor of the polyimide system resin of a heat-curing mold is used, it can harden by carrying out heating cure processing.

[0081] Although heating curing temperature changes with classes of 1st light-permeability layer precursor 142a, it is about 150 degrees C more preferably 280 degrees C or less 100-400 degrees C. When heating curing temperature is 280 degrees C or less, the anomalous diffusion of electrode material can be prevented certainly. When heating curing temperature is about 150 degrees C, there is the following two effectiveness. 1) The damage by the heat of components, such as a surface emission-type laser, is avoidable. 2) The differential thermal expansion of the semi-conductor deposition object 120 and 1st light-permeability layer precursor (polyimide system resin) 142a can be made small.

[0082] In this way, on the semi-conductor deposition object 120, the 1st light-permeability layer 142 which has the reversal configuration of the mold side 182 of 1st La Stampa 180 is formed. That is, the 1st lens side 150 is formed in the part corresponding to the 1st heights 184 of 1st La Stampa 180, and the hole 162 for contact hole 160 formation is formed in the part corresponding to the 2nd heights 186.

[0083] (6) As shown in the 1st exfoliation process, next drawing 3 (c) of La Stampa, exfoliate 1st La Stampa 180 from the 1st light-permeability layer 142 and semi-conductor deposition object 120. As mentioned above, in the mold side 182 of 1st La Stampa 180, it is desirable that surface treatment is performed. By performing surface treatment to the mold side 182, 1st La Stampa 180 can be easily exfoliated from the 1st light-permeability layer 142 and semi-conductor deposition object 120.

[0084] <Formation of the 2nd light-permeability layer>, next the formation approach of the 2nd light-permeability layer 144 are explained. Drawing 4 is the sectional view showing typically the formation process of the 2nd light-permeability layer 144.

[0085] (1) Carry out alignment of 2nd La Stampa 190 of an alignment process of the 2nd La Stampa and a semi-conductor deposition object, and the semi-conductor deposition object 120. This alignment is performed so that the crevice 194 of 2nd La Stampa 190 and the pillar-shaped section 101 of the semi-conductor deposition object 120 may counter. Since the alignment approach is the same as that of the above-mentioned formation process (2) of the 1st light-permeability layer 142, detailed explanation is omitted. In addition, the crevice 194 of 2nd La Stampa 190 has the reversal configuration of the 2nd lens side 152 which it is going to obtain. The heights 196 of 2nd La Stampa 190 have the reversal configuration of the contact hole 160 which it is going to obtain. Except a configuration, since the concrete configuration of 2nd La Stampa 190 is the same as that of 1st La Stampa 180, it omits the explanation.

[0086] (2) Introduce 2nd liquefied light-permeability layer precursor 144a between 2nd La Stampa 190 of an introductory process of the 2nd light-permeability layer precursor, and the semi-conductor deposition object 120. And 2nd light-permeability layer precursor 144a is carried on the field of the semi-conductor deposition object 120. In addition, 2nd light-permeability layer precursor 144a may be carried on the field of 2nd La Stampa 190. When 2nd light-permeability layer precursor 144a becomes the 2nd light-permeability layer 144, the ingredient of 2nd light-permeability layer precursor 144a will not be limited especially if the refractive index of the 2nd light-permeability layer 144 becomes larger than the refractive index of the 1st light-permeability layer 142. The example of the desirable ingredient of 2nd light-permeability layer precursor 144a is the same as that of 1st light-permeability layer precursor 142a. In addition, the example of the approach of introducing 2nd light-permeability layer precursor 144a between 2nd La Stampa 190 and the semi-conductor deposition object 120 is the same as that of the 1st light-permeability layer 142.

[0087] (3) The 2nd light-permeability layer 144 as well as the 1st light-permeability layer 142 can be hereafter formed to formation of the 2nd light-permeability layer. That is, the 2nd light-permeability layer 144 can be formed like the approach from the adhesion process (4) of the 1st above-mentioned La Stampa 180 and the above-mentioned semi-conductor deposition object 120 to the exfoliation process (6) of 1st La Stampa 180. In this way, as shown in drawing 4 (b), the 2nd lens side 152 is formed in the front face of the 2nd light-permeability layer 144 above the pillar-shaped section 101. Moreover, a contact hole 160 is formed in the position of the light transmission nature layered product 140.

[0088] (4) After exfoliating 2nd La Stampa 190 of processing of the pars basilaris ossis occipitalis of a contact hole, in the pars basilaris ossis occipitalis of a contact hole 160, the constituent of the light transmission nature layered product 140 may remain. For example, survival of the constituent of the light transmission nature layered product 140 may produce the following three problems.

[0089] 1) There is a case where it becomes impossible to fully aim at electric contact in the up electrode 106 and its metal layer to prepare a metal layer on the light transmission nature layered product 140, and take electric contact for this metal layer and the up electrode 106 through a contact hole 160 to the 1st.

[0090] 2) If it is in the condition in which the constituent of the light transmission nature layered product 140 remained, for example, wire bond is directly performed [2nd] to the up electrode 106 at the pars basilaris ossis occipitalis of a contact hole 160, the problem connection becomes impossible to the up electrode 106 may produce a wire.

[0091] 3) Even if a wire is [3rd] connectable with the up electrode 106, the problem it becomes impossible to fully plan may produce the electric contact to a wire and the up electrode 106.

[0092] In order to prevent the above problem certainly, when the constituent of the light transmission nature layered product 140 remains, in the pars basilaris ossis occipitalis of a contact hole 160, it is desirable to remove the constituent which remained. When the constituent of the light transmission nature layered product 140 consists of resin, it can remove by one of approaches between two approaches shown below.

[0093] 1) It is the approach 1st ashing removes the resin which remained at the pars basilaris ossis occipitalis of a contact hole 160. Here, ashing is the approach of making resin reacting with reactant gas and removing it in a gaseous phase. Ozone ashing, plasma ashing, etc. can be mentioned as an example of ashing. Ozone ashing is the approach of carrying out the chemical reaction of ozone and the resin, and removing resin under the ambient atmosphere of high-concentration ozone. Plasma ashing is the approach of generating the plasma of oxygen gas and removing resin using the plasma. Since the resin about all the contact holes 160 with which resin remained is removable according to the approach by such ashing, there is an advantage of not requiring the processing time.

[0094] 2) It is the approach of 2nd carrying out ablation of the pars basilaris ossis occipitalis of a contact hole 160 by excimer laser. That is, it is the approach of doubling collimation, irradiating the excimer laser beam extracted finely at the pars basilaris ossis occipitalis of a contact hole 160, and burning off the resin of the pars basilaris ossis occipitalis of a contact hole 160. According to the excimer laser, since only the pars basilaris ossis occipitalis of a contact hole 160 can be processed, there is certainly an advantage that it is not necessary to worry about breakage of the 2nd lens side 152.

[0095] (5) The surface emission-type laser 100 as exfoliates and shows the exfoliation process back up plate 170 of the back up plate to drawing 1 is completed.

[0096] (The focus and the operation effectiveness) The focus about the manufacture approach of a surface emission-type laser 100 and the operation effectiveness concerning the gestalt of the 1st operation are explained hereafter. The characteristic point of the manufacture approach of the surface emission-type laser 100 concerning the gestalt of the 1st operation is the following point.

[0097] (1) It is the point which forms the 1st lens side 150 and the hole 162 for a contact hole 160 in the 1st in one using 1st La Stampa 180. For this reason, by the photolithography method, compared with forming the 1st lens side 150 and hole 162, it is easy, and the time amount which manufacture takes can be shortened sharply. Moreover, since La Stampa 180 can be again used repeatedly once it creates it, it can reduce a manufacturing cost and is economical.

[0098] (2) It is the point which forms the 2nd lens side 152 and contact hole 160 in the 2nd in one using 2nd La Stampa 190. For this reason, the same operation effectiveness as the focus (1) can be done so.

[0099] [Manufacture approach of La Stampa] La Stampa can be manufactured as follows, for example. Here, the manufacture approach of 2nd La Stampa 190 is explained.

[0100] (Formation of a mother mold) In manufacturing 2nd La Stampa 190, the mother mold used as the matrix of 2nd La Stampa 190 is manufactured. First, the manufacture approach of a mother mold is explained. Drawing 5 is the mimetic diagram having shown the production process of the mother mold 14.

[0101] (1) Apply a photoresist on the high silicon substrate 10 of surface smoothness. Then, using the photolithography method, by carrying out patterning of the photoresist, as shown in drawing 5 (a), the 2nd resist layer R2 of a predetermined pattern is formed.
[0102] (2) Next, carry out a heating reflow of the 2nd resist layer R2. That is, it fuses, and the 2nd resist layer R2 is made to flow, and carries out the reconstititution. Thereby, as the 2nd resist layer R2 is shown in drawing 5 (b) in response to the effect of surface tension, it deforms into a convex lens configuration and the 3rd resist layer R3 is formed. For example, it can carry out, using a hot plate or warm air circuit system oven as the heating approach. Although the heating conditions at the time of using a hot plate change according to the quality of the material of a resist, they are 150 degrees C or more, and are 5 minutes preferably for 2 to 10 minutes. Moreover, in the case of warm air circuit system oven, it is 160 degrees C or more, and 20 – 30 minutes is suitable for it.
[0103] (3) Next, etch the 3rd resist layer R3 and silicon substrate 10, and imprint the configuration of the 3rd resist layer R3 to a silicon substrate 10. In this way, as shown in drawing 5 R> 5 (c), the convex configuration section 11 is formed on a silicon substrate 10. Although this etching changes with configurations of a lens side to acquire, it is performed by the dry etching method the selection ratios (the etching rate of silicon / etching rate of the 3rd resist layer) (henceforth a "selection ratio") of silicon to the 3rd resist layer R3 are 0.5–1.0, for example. The convex configuration section 11 formed here is equipped with the configuration of the 2nd lens side 152 of the surface emission–type laser finally manufactured. According to this selection ratio, in this etching, the configuration of the 3rd resist layer R3 can be imprinted to a silicon substrate 10, making the configuration of the 3rd resist layer R3 reflect, as the fictitious outline of drawing 5 (b) shows. Consequently, the silicon substrate 10 convex configuration section 11 can be formed. The gas which mixed the oxygen which etches a resist layer into the high gas (for example, CF4) of etching nature positively to silicon as etching gas can be mentioned. Thus, a selection ratio can be adjusted by mixing oxygen.
[0104] (4) Next, apply a photoresist on a silicon substrate 10. Then, using the photolithography method, by carrying out patterning of the photoresist, as shown in drawing 5 (d), the 4th resist layer R4 of a predetermined pattern is formed. Then, the position of a silicon substrate 10 is etched even into the desired depth by using the 4th resist layer R4 as a mask, and a hole 12 is formed. The hole 12 formed here is equipped with the configuration of the contact hole 160 of the surface emission–type laser 100 finally manufactured. This etching is the big etching gas 4 of a selection ratio, for example, CF. It carries out using gas etc. The 4th resist layer R4 is removed after etching. In this way, as shown in drawing 5 (e), the mother mold 14 equipped with the configurations of the 2nd lens side 152 of a surface emission–type laser 100 and a contact hole 160 finally manufactured is completed.
[0105] (Formation of La Stampa) How to form La Stampa 190 is hereafter explained using the mother mold 14 obtained here. Drawing 6 is the mimetic diagram having shown the process which forms La Stampa 190 using a mother mold.
[0106] (1) As shown in drawing 6 (a), carry liquefied ultraviolet curing mold resin 30 on the field which has the convex configuration section 11 and the hole 12 of the mother mold 14.
[0107] (2) Next, stick the transparent back up plate 20 with the mother mold 14 through liquefied ultraviolet curing mold resin 30 to ultraviolet rays. Thus, by sticking the back up plate 20 and the mother mold 14, to a predetermined field, it applies and liquefied ultraviolet curing mold resin 30 can be opened, as shown in drawing 6 (b). As the back up plate 20, the plate which consists of borosilicate glass can be mentioned, for example.
[0108] (3) Next, by irradiating ultraviolet rays 24 from a back–up–plate 20 side to liquefied ultraviolet curing mold resin 30, stiffen liquefied ultraviolet curing mold resin 30, and form the middle board 32. Then, as shown in drawing 6 (c), the middle board 32 and the back up plate 20 are exfoliated from the mother mold 14 in one. In this way, 2nd La Stampa 190 which consists of the middle board 32 and the back up plate 20 is formed. In this way, the reversal configurations of the convex configuration section 11 of the mother mold 14 and the configuration of a hole 12 are imprinted by the acquired mold side 192. That is, the mold side 192 of 2nd La Stampa 190 has a crevice 194 and heights 196. A crevice 194 turns into the reversal configuration section of the 2nd lens side 152, and heights 196 turn into the reversal configuration section of a contact hole 160.
[0109] (4) Subsequently, as shown in drawing 6 (d), perform surface treatment to the mold side 192. This surface

treatment is processing to which it is made for the adhesion of the light transmission nature layered product 140 and 2nd La Stampa 190 to become lower than the adhesion of the light transmission nature layered product 140 and the semi-conductor deposition object 120. As this surface treatment, it is CF4, for example. The fluoridization by the gas plasma etc. can be mentioned. In this way, 2nd La Stampa 190 is completed.

[0110] The surface emission-type laser concerning the gestalt of the 2nd operation and its manufacture approach are explained below (the gestalt of the 2nd operation).

[0111] [Surface emission-type laser] The surface emission-type laser concerning the gestalt of the 2nd operation is explained first. Drawing 7 is the sectional view showing typically the surface emission-type laser 200 concerning the gestalt of the 2nd operation.

[0112] (Structure of a device) The surface emission-type laser 200 concerning the gestalt of the 2nd operation is an example of an array for which the semi-conductor deposition object 220 has two or more resonators. The surface emission-type lasers 200 concerning the gestalt of the 2nd operation are the laminated structure of the light transmission nature layered product 240, and the point that the light transmission nature layered product 240 has the separation slot 270, and differ from the gestalt of the 1st operation. Since the other point is the same as the gestalt of the 1st operation, detailed explanation is omitted. Moreover, in drawing 7 , illustration of the layer structure of the semi-conductor deposition object 220 is omitted, the outline of the semi-conductor deposition object 220 is carried out, and it is shown.

[0113] The semi-conductor deposition object 220 has two or more pillar-shaped sections 201. On the semi-conductor deposition object 220, the light transmission nature layered product 240 is formed. The light transmission nature layered product 240 is a three-tiered structure. That is, on the semi-conductor deposition object 220, the laminating of the 1st light-permeability layer 242, 2nd light-permeability layer 244, and 3rd light-permeability layer 246 is carried out one by one, and the light transmission nature layered product 240 is constituted.

[0114] The interface of the 1st light-permeability layer 242 and the 2nd light-permeability layer 244 has the 1st lens side 250 [above the pillar-shaped section 201]. The 1st lens side 250 is a convex in the opposite side to the semi-conductor deposition object 220. The 1st lens side 250 has the function to make the laser beam by which outgoing radiation was carried out from the pillar-shaped section 201 condense.

[0115] The interface of the 2nd light-permeability layer 244 and the 3rd light-permeability layer 246 is above the pillar-shaped section 201, and has the 2nd lens side 252. The 2nd lens side 252 is a convex at the semi-conductor deposition object 220 side. The 2nd lens side 252 has the function to make the laser beam by which outgoing radiation was carried out from the pillar-shaped section 201 condense further.

[0116] The front face of the 3rd light-permeability layer 246 has the 3rd lens side 254 [above the pillar-shaped section 201]. The 3rd lens side 254 is a convex in the opposite side to the semi-conductor deposition object 220. The laser beam by which outgoing radiation was carried out from the pillar-shaped section 201 can be made to condense further in the 3rd lens side 254.

[0117] And the optical axis of the lens side 250,252,254 of the 201 or 3 pillar-shaped sections is in agreement.

[0118] The quality of the material of the 1st light-permeability layer 242 and the 3rd light-permeability layer 246 is determined by relation with the quality of the material of the 2nd light-permeability layer 244. That is, compared with the 2nd light-permeability layer 244, the quality of the material of the 1st light-permeability layer 242 and the 3rd light-permeability layer 246 will not be limited; especially if a refractive index is the large quality of the material. The ingredient which was stiffened by giving energy to a liquefied object as the quality of the material of the 1st - the 3rd light-permeability layer 242,244,246, and was obtained is desirable. The reason nil why such an ingredient is desirable is that it can form a light-permeability layer 242,244,246 using La Stampa.

[0119] Two or more contact holes 260 are formed in the light transmission nature layered product 240. The contact hole 260 is formed so that the up electrode (not shown) which follows the pillar-shaped section 201 may be exposed.

[0120] The separation slot 270 is formed in the mutual light transmission nature layered product 240 of the pillar-shaped section 201. This separation slot 270 has the function to stop a cross talk. Here, the laser beam by which

outgoing radiation was carried out from one pillar-shaped section 201 spreads a cross talk horizontally, and it means the phenomenon in which the laser beam begins to leak from the light transmission nature layered product 240 in the adjoining pillar-shaped section 201.

[0121] The separation slot 270 has the function to stop a cross talk, by the following reason. A part of laser beam by which outgoing radiation was carried out from one pillar-shaped section 201 carries out the horizontal transmission of the light transmission nature layered product 240. If the separation slot 270 exists between the pillar-shaped sections 201, this laser beam will be reflected in side-attachment-wall side (henceforth "side-attachment-wall side of light transmission nature layered product") 270a of the light transmission nature layered product 240 in the separation slot 270. For this reason, the rate that the laser beam which has carried out horizontal transmission passes through the separation slot 270 is stopped. Thus, the separation slot 270 can stop a cross talk.

[0122] Although especially the flat-surface configuration of the separation slot 270 is not limited, it can raise a rectangle, for example. As for the flat-surface configuration of a separation slot, it is desirable to have a concave convex part. If the plane of the separation slot 270 has a concave convex part, the function to stop a cross talk will improve more by the following two reasons. 1) Since the laser beams which have carried out horizontal transmission are scattered on the 1st by side-attachment-wall side 270a of the light transmission nature layered product 240. 2) Since the coherency (coherency) of a laser beam is disturbed by the 2nd by side-attachment-wall side 270a of the light transmission nature layered product 240.

[0123] If it is extent which can demonstrate the function as the depth of the separation slot 270, it is not limited especially, for example, is more than one half of the thickness T1 of the light transmission nature layered product 240.

[0124] The die length L1 of the separation slot 270 can take the mode which can demonstrate the function and which it was not limited especially when it was the grade, for example, was made larger than the effective diameter D1 of the 3rd lens side 254.

[0125] (The focus and the operation effectiveness) The focus about a surface emission-type laser 200 and the operation effectiveness concerning the gestalt of the 2nd operation are explained hereafter. The characteristic point of the surface emission-type laser 200 concerning the gestalt of the 2nd operation is the following point.

[0126] (1) It has the focus (1) which starts the gestalt of the 1st operation the 1st, and the same focus as (2). For this reason, the publication of that focus and the operation effectiveness is omitted.

[0127] (2) It is the light transmission nature layered product's 240 being constituted from a light-permeability layer 242,244,246 of three layers by the 2nd, and having three lens sides 250,252,254 in it. Thus, since many one lens side is formed compared with the gestalt of the 1st operation, the light transmission nature layered product 240 concerning the gestalt of the 2nd operation can narrow a radiation angle more.

[0128] (3) It is that the separation slot 270 is formed in the 3rd at the position of the light transmission nature layered product 240. Since the separation slot 270 is formed, a cross talk can be stopped.

[0129] The surface emission-type laser 200 concerning the gestalt of the [manufacture approach of surface emission-type laser] 2nd implementation can be manufactured by the same approach as the gestalt of the 1st operation. That is, the surface emission-type laser 200 concerning the gestalt of the 2nd operation can be manufactured by the approach using La Stampa.

[0130] (Modification of a separation slot) Two following deformation is possible for the separation slot 270.

[0131] (1) As shown [1st] in drawing 8 , the protection-from-light nature ingredient 272 may be embedded in the separation slot 270. The protection-from-light nature ingredient 272 will not be limited especially if it is the quality of the material which may absorb a laser beam. The concrete protection-from-light nature ingredient 272 can mention what melted the black color or the black pigment to the solvent with binder resin. As an approach of embedding the protection-from-light nature ingredient 272 in the separation slot 270, the approach using an ink jet method can be mentioned, for example.

[0132] (2) As a cross-section configuration of the separation slot 270, you may be a V character configuration the 2nd. The separation slot 270 can be easily formed as the cross-section configuration of the separation slot

270 is a V character configuration.

[0133] (Modification) this invention is not limited to the gestalt of the above-mentioned operation, but various modification is possible for it in the range of the summary of this invention. For example, the next modification is possible.

[0134] (1) Various lens operations can be acquired by changing the configuration of a lens side and curvature which were formed in the interface of a light-permeability layer, and the refractive index of a light-permeability layer, and combining them. This lens operation is spherical aberration and chromatic aberration.

[0135] (2) When a semi-conductor deposition object has two or more resonators, a resonator can be arranged by the predetermined pattern and the surface emission-type laser of this invention can be made into the surface light source. This surface light source is applicable to a laser beam printer by arranging for example, a luminescence unit (resonator) alternately, in the shape of Rhine, etc. moreover, this surface light source — for example, a luminescence unit (resonator) — ** — it is applicable to the flat-surface light source by arranging densely.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the sectional view showing typically the surface emission-type laser concerning the gestalt of the 1st operation.

[Drawing 2] It is the cross section of the production process of the surface emission-type laser concerning the gestalt of the 1st operation.

[Drawing 3] It is the cross section of the production process of the surface emission-type laser concerning the gestalt of the 1st operation.

[Drawing 4] It is the cross section of the production process of the surface emission-type laser concerning the gestalt of the 1st operation.

[Drawing 5] It is the sectional view showing the production process of La Stampa typically.

[Drawing 6] It is the sectional view showing the production process of La Stampa typically.

[Drawing 7] It is the sectional view showing typically the surface emission-type laser concerning the gestalt of the 2nd operation.

[Drawing 8] It is the sectional view showing typically the modification of the surface emission-type laser concerning the gestalt of the 2nd operation.

[Description of Notations]

10 Silicon Substrate

11 Convex Configuration Section

12 Hole

14 Mother Mold

20 Back Up Plate
24 Ultraviolet Rays
30 Liquefied Ultraviolet Curing Mold Resin
32 Middle Board
100,200 Surface emission-type laser
101,201 Pillar-shaped section
102 Contact Layer
103 Up DBR Mirror
104 Lower DBR Mirror
105 Quantum Well Barrier Layer
106 Up Electrode
107 Lower Electrode
108 Insulating Layer
109 N Mold GaAs Substrate
120,220 Semi-conductor deposition object
140,240 Light transmission nature layered product
142,242 The 1st light-permeability layer
142a, 242a Precursor of the 1st light-permeability layer
144,244 The 2nd light-permeability layer
144a, 244a Precursor of the 2nd light-permeability layer
150,250 1st lens side
152,252 2nd lens side
160,260 Contact hole
170 Back Up Plate
180 1st La Stampa
182 Mold Side
184 1st Heights
186 2nd Heights
190 2nd La Stampa
192 Mold Side
194 Crevice
196 Heights
246 3rd Light-permeability Layer
254 3rd Lens Side
270 Protection-from-Light Slot
272 Protection-from-Light Nature Ingredient
D1 Diameter of the 3rd lens side
L1 The die length of the long side of a protection-from-light slot
T1 Thickness of a light transmission nature layered product
R1 1st resist layer
R2 2nd resist layer
R3 3rd resist layer
R4 4th resist layer

[Translation done.]